Power, Kirchhoff, Mock 1+2

Final IA
Turnitin.com
ID: 16307795
key: Physics
due Sunday night before midnight

You connect a 1.5V electrochemical cell to a resistor and an ammeter (measures current). The ammeter reads 30.0 mA.

a) what is the resistance of the resistor?
R=V/I = 1.5/(0.030)=50.0 Ω

b) what is the amount of charge passing the resistor in 5.0 s?
I=q/t q=It = 0.030x5=0.15 C

c) How many electrons pass in that time?
q= 0.15C e=1.602x10^{-19}C
#e = 0.15C/1.602C/e=0.0936e=9.4x10^{17} electrons

d) How much energy is dissipated by the resistor in that time? Where does it go?
V=energy/q energy = Vq 1.5x0.15=0.225 J lost as heat or

e) derive the equation for the power dissipated by an electrical element given V, I or R.
P=work/time = energy/time energy = Vq
P=Vq/t hey , q/t = I
P=VI where V is the voltage difference across the circuit element (not necessarily the whole circuit)

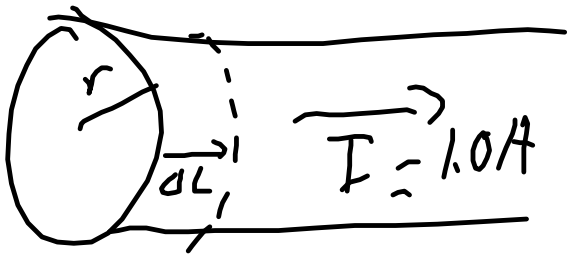
I is the current through the element
For Ohmic devices (R is constant) then V=IR

$P=VI=I^2R=V^2/R$

P=energy/time so energy = Pt = VIt = 1.5x0.03x5= 0.225 J same answer

p477 Q1-9 start with Q9 for a challenge

Q9



$\rho = 10^{29}\ e^-/m^3$

r = 1.0mm

$V = A \times h = \pi r^2 \Delta L$

$\rho = \frac{q}{V}$ $I = \frac{q}{t}$

$I = \frac{\rho V}{t} = \rho \pi r^2 \frac{\Delta L}{t}$

$I = \rho \pi r^2 v$

$$v = \frac{I}{\rho \pi r^2} = \frac{1.0\,A}{\frac{10^{29}\,e^-}{m^3} \cdot \pi\,(0.001\,m)^2 \cdot \frac{1.602 \times 10^{-19}\,C}{e^-}}$$

1/(1E29x1.602E-19x3.14159x0.001^2)=
2.0E-5
2.0×10^{-5}m/s wow, slow!

so how come the lights turn on right away when I hit the switch, even if the electrons are drifting really slowly?

the wires are filled with free electrons/ the electric field travels down the wire at near the speed of light

Resistivity -
What factors influence the resistance of a wire?
the material - copper is a great conductor, gold is the best element, superconductors can have wires with no energy loss as heat in the wire.

temperature

length and cross-sectional area

$\rho = RA/L$ IB data booklet
or in the book $R = \rho A/L$

R is the resistance of the wire, in Ohms, Ω
A is the cross-sectional area (πr^2)
L is the length of the wire
ρ = resistivity - depends on the material and temperature

1. What is the resistance of a 20.0 cm length of 1.0mm radius copper wire?
$\rho = 1.72 \times 10^{-8}$ Ω/m

2. You put 500 ml (500g) of water in a 1200W kettle connected to a 120V wall socket. Determine the

a) current through the heating element
b) resistance of the heating element
c) time to bring the water to the boiling point from 20ºC (c=4180J/kgK)
d) efficiency of the kettle if it takes 20minutes

Giancoli, p477-478 Q11-31 odds

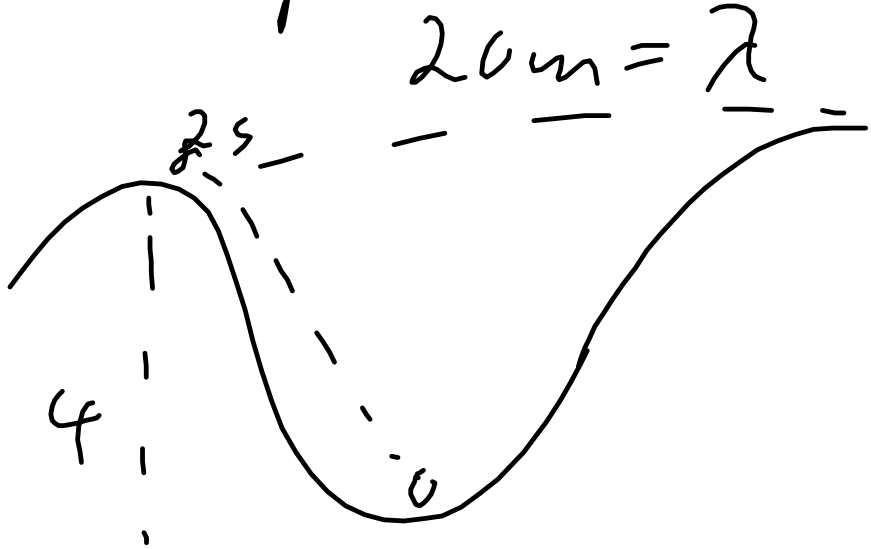
$$F_c = m\frac{v^2}{r}$$

$$r = \frac{mv^2}{F_c}$$

$$g = \frac{GM}{r^2}$$

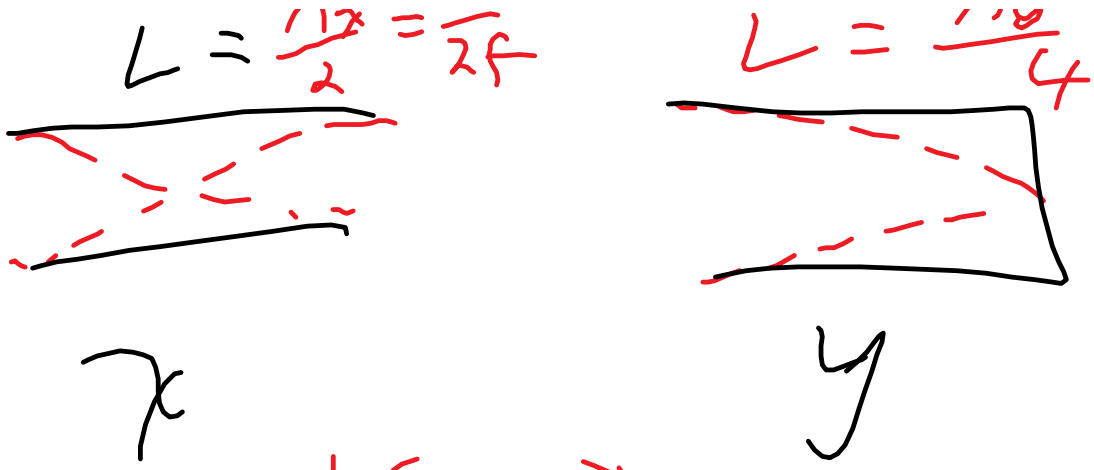
$$v = \lambda f$$

$$v = \frac{\lambda}{T} = \frac{20}{4} = 5\,m$$



$$20m = \lambda$$

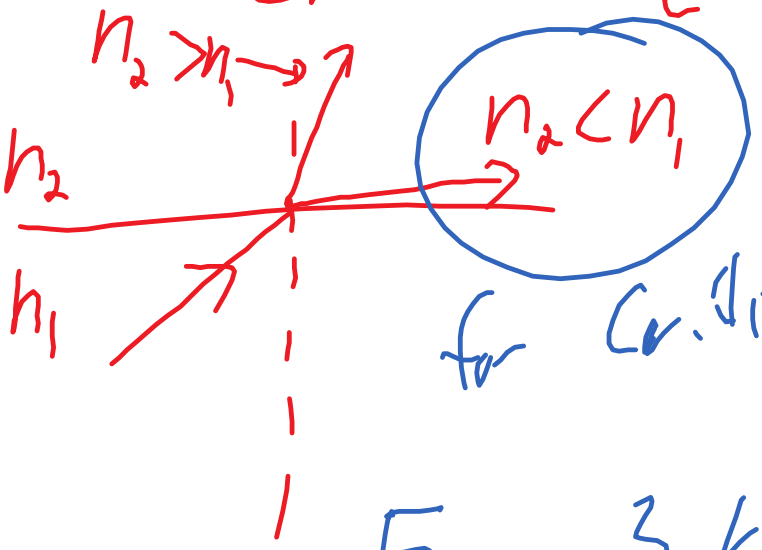
$$L = \frac{\lambda_x}{2} = \frac{v}{2f} \qquad L = \frac{\lambda_y}{4}$$



$$\frac{v}{2f_x} = \frac{v}{4f_y} \qquad f_b = f_2 - f_1$$

$$f_y = \frac{1}{2} f_x$$

Critical $\theta_c = \sin^{-1} \frac{n_2}{n_1}$



for Critical

$$E_k = \frac{3}{2} k_B T$$

$$W = F \times d =$$

$$P = \frac{F}{A}$$

$$F = PA$$

$$W = PA\Delta L$$

$$W = P\Delta V$$

$$E_{max} = hf - \phi$$

ϕ ↗ work function

$$V = \frac{\text{energy}}{q}$$

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